received during the last five years by the twelve colleges which participate in the grant amounts to close upon one million sterling. (2) The total number of day students attending the colleges during the session ending in July, 1901, was 7825, as against 7186 attending during the session ending July, 1896. (3) The advance in the standard of work is more striking than the advance in numbers. This advance is best shown by the larger number of university degrees obtained by students. The aggregate figures for the two periods are as follows:—1891-6, 1437 degrees; 1896-1901, 2186 degrees.

Position of Teachers.—Nothing has impressed us more than the enormous amount of routine work which the majority of university colleges exact from their teachers. There are, it is true, several exceptions. In certain colleges and in particular departments in which the number of students is small, the professors and their assistants have a good deal of leisure, and are able to undertake literary and scientific work with the support, in some cases, of fairly satisfactory libraries and laboratory appliances. In the larger and more successful colleges and departments the pressure upon the time and thought of the teachers is unduly great. If the head of a department is to maintain a high standard of teaching and to ensure a creditable list of examination successes he has little leisure for private work, and especially is he obliged to be assiduous in his duties because the students of the university colleges belong, for the most part, to a social class which exacts the maximum return in results for the fees paid. As to the effect of too much work upon the teacher there is no room for doubt. It tends to sap his intellectual vitality by leaving him neither time nor energy to draw fresh inspiration from the study of the work of others or from his own investigations. A fresh and unharassed mind is, above all things, necessary for research.

There is another respect in which, as it appears to us, the colleges are not serving their own best interests by overworking their teachers. The stipends which they offer are, for the most part, distinctly moderate. The opportunities for continued study and research are, except in London, inferior to those which Oxford and Cambridge afford. It can hardly be expected, nor is it to be desired, that a man of real capacity should look upon an appointment at a provincial college as a settlement for life. Rather should he regard it as a stepping-stone to preferment. If the colleges were to realise that the smallness of the stipend which they offer would be more than compensated in the eyes of an ambitious man by larger opportunities of qualifying for preferment, they would attract to their service young men of the greatest promise. If the probability of the advancement of its professors and lecturers to more lucrative and important posts is kept in view and their duties so arranged as to allow them leisure to display their capacity for original work, the colleges may count upon a supply of young men of the greatest ability who will occupy their chairs for a certain number of years while waiting to be called to a wider sphere.

Research.—We have found it difficult to give any adequate idea of the amount of original research in science which has been carried out by the teachers and students of the several colleges during the quinquennium under review. The greater part of the research work carried out at provincial colleges is done by heads of departments, and we recognise that a summary of each professor's own work would have greatly increased the value of our report. For several reasons, however, we have not felt ourselves at liberty to attempt this. In the first place, the leisure and, therefore, the opportunities for research, which the professors enjoy vary immensely. In the majority of cases we should say that the professor's duties are far too arduous and incessant to allow him to do much work of this kind. In the second place, we find that certain professors hold that it is the duty of the head of a department to work through his students. To them he conveys his ideas and affords constant assistance in carrying them out. A teacher who adopts this point of view may publish nothing under his own name, although all the work which emanates from his laboratory is really inspired by him.

Students and Original Research.—With regard to the question of the desirability of encouraging students to undertake original investigations, we find that teachers hold diametrically opposed views. Some consider that to set a student to such work is to rob him of the opportunity which his student days afford of acquiring information. Others look upon experience in research as the best training which any student can receive. The amount of research work done by students depends, therefore, to a certain extent upon the position which professors take with regard to this question. It may also be noted that the effort and originality required to produce "a paper" in some subjects is very different from that required in others. Probably the scope for original work in science is greatest in chemistry and least in physiology. In chemistry, too, the making of new substances and the investigation of interactions is a training in the science to a much greater extent than is similar work in any biological subject.

University Colleges and Secondary Schools.—We find that the relations of the more important provincial colleges to the secondary schools of their districts have become distinctly closer in the last five years. Not merely do more pupils pass from the secondary schools to the colleges, but reciprocity of representation on the governing bodies of schools and colleges is becoming more frequent, and there has been a certain amount of inspection of secondary schools carried out by members of the staff of several of the colleges. Another significant fact is that there have been of late several instances of denominational colleges, especially training colleges for the Nonconformist ministry, settling near university colleges in order that their students may attend university courses in arts and science. These facts point to the increasing importance of university colleges as educational centres.

University Colleges and Technical Education.—In an ever-increasing degree the university colleges are serving to co-ordinate the various agencies for higher education into an effective whole. They serve to focus educational forces. Particularly is their integrating action noticeable on the technological side, and although their results in this direction are not the phases of their activity which we were commissioned to investigate, they are, in our opinion, so desirable that we venture to call attention to them. Technical institutes are growing up in all large towns. When they are not in direct connection with the university colleges, where such exist, there is inevitably a certain amount of rivalry, with consequent friction, overlapping and waste of energy. The scientific direction of technological studies is a matter of national importance. In the technical departments of a university college, technical education is lifted to a higher plane. The head of a technical department, who is also a member of a college staff, and in close touch with the heads of departments of pure science, takes a higher and wider view of his own work, and inspires a more scientific spirit in his pupils. Further than this, the more capable of his pupils have the opportunity of prosecuting the study of the pure sciences as far as their inclination or financial resources allow. Not infrequently they discover in themselves an aptitude for science which would never have been suspected had they not joined a technical department for the purpose of acquiring instruction which would enable them to earn a living. In departments which would at first sight appear to be the most distinctly technical, we found that researches were being prosecuted which were helping to solve questions of general interest to men of science, the results reaching far beyond the interest of the particular industry to which the department belonged. Every year the boundaries which separate pure science from applied science become more indistinct. The physicist, the chemist and biologist make discoveries which prove to be unexpectedly useful in their application, while the technologist, going farther and farther afield, undertakes researches, the applications of which he cannot foresee, in the hope that he may light upon results which commerce can turn to account.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE pass list of the D.Sc. examination of the University of London contains the following names:—Mixed mathematics, Louis N. G. Filon (Granville scholarship); experimental physics, G. J. Parks, W. Watson; chemistry, R. H. Aders, R. M. Caven, C. H. Desch, E. J. Russell, J. Wade, Martha Annie Whiteley; botany, F. E. Weiss; zoology, H. S. Harrison (Sherbrooke scholarship), H. H. Swinnerton; physiology, Florence Buchanan, F. G. Hopkins; geology, C. A. Matley, E. W. Skeats.

THE Annual Calendar of the McGill College and University, Montreal, for the session 1902-1903 is a volume of more than four hundred pages filled with details of the buildings and equipment of the various departments, and the courses of work

carried on in them. The three buildings endowed and equipped by Sir William C. Macdonald for engineering, chemistry and mining, and physics, afford excellent facilities for study and research. There are special laboratories and workshops in which machinery of full size has been erected, so that all investigations can be carried on in all respects under working conditions.

THE tenth report of the Technical Instruction Committee of the County Borough of Plymouth has been received. The concluding words of the report show that the committee realises that fundamental principles rather than technical details should be the object of the work in such municipal science, art and technical schools as that at Plymouth. The committee remarks:—"It must not be assumed that the work of the schools is intended to embrace what are commonly called technical subjects only. Their object is to give such higher education and training, combined with manual and technical skill, as may enable their students to perform their work in life with greater intelligence, ability and success."

SINCE Prof. Perry brought forward the subject of "The Teaching of Mathematics" at the meeting of the British Association last September, several associations of teachers have discussed the reforms suggested or appointed committees to report upon the matter. A committee of the Assistant Masters' Association has had the subject under consideration, and a preliminary report has been drawn up, from which it appears that masters in secondary schools are in favour of most of the reforms advocated by speakers at the British Association meeting. The report is as follows:—I. *Arithmetic.* (1) The method of teaching in the early stages should be inductive and concrete. Actual measuring and weighing should be introduced as early as possible. (2) Decimals should be treated as an extension of the ordinary notation, their nature being illustrated by actual metric weights and measures. Multiplication and division of a decimal by a decimal would, we think, have to follow vulgar fractions. (3) The decimalisation of English money and English weights and measures should be practised frequently. (4) Approximate methods should be gradually introduced after the treatment of finite decimals. They should be taught with due regard to rigidity of proof. Appreciation of the degree of approximation should be continually insisted upon. (5) If "commercial arithmetic" is to be taught at all, the subject-matter should receive more adequate and correct treatment, and the examples should be drawn from transactions as they actually occur.—II. *Algebra.* (1) The foundation of algebra should be "literal arithmetic," *i.e.* algebra should at first be arithmetic generalised. (2) The minus sign should receive its extended meaning from copious illustrations; and illustrations, not rigid proof, should also be resorted to for the purpose of the "rule of signs." (3) Algebra should often be applied to geometry. (4) Logarithms should form an important section of the subject. We believe that the graphic method could be very usefully employed in this connection. (5) We desire to deprecate the waste of time so commonly practised in mere manipulation of symbols.—III. *Geometry.* (1) We are strongly of opinion that the ordinary deductive geometry should be preceded and continually supplemented by concrete and inductive work. (2) Whilst "mensuration" might possibly be taught in connection with physics and arithmetic, we believe that the value of geometry would be enhanced by practical applications of the propositions as they occur. (3) We feel very strongly that Euclid's text is very unsuitable for teaching geometry. But we are impressed with the difficulty of abolishing its use in the face of external examinations. In the circumstances, we can only hope that examining bodies, even if they insist on Euclid's sequence, will allow greater latitude in methods of proof, and give greater prominence to easy "riders" and applications of geometry.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 12.—"The Dissipation of Energy by Electric Currents induced in an Iron Cylinder when rotated in a Magnetic Field." By Ernest Wilson, Professor of Electrical Engineering, King's College, London.

The effect which induced currents have upon the distribution of magnetism in an iron cylinder, when rotated about its longitudinal axis with uniform angular velocity in a magnetic field, has already formed the subject of a communication (Wilson, Roy. Soc. *Proc.*, vol. lxix. p. 435, also NATURE, vol. lxv. p. 502). The present paper deals with the energy dissipated by these electric currents, and a comparison is made between the results of experiment and theory. In connection with the theory of the subject a contribution by Mr. J. B. Dale is made use of. The cylinder experimented upon has diameter and length each 10 inches (25·4 cm.), and is rotated between the poles of a magnet weighing some tons. It is supplied with exploring coils, threaded through holes drilled in a plane containing its longitudinal axis, by the aid of which the electromotive forces due to rotation in a magnetic field have been observed. The results of experiment have been obtained graphically by a process of double integration. The distribution which has to be assumed in connection with the experiments is that the induced currents distribute themselves on the surfaces of cylinders similar to and concentric with the cylinder experimented upon. Two other distributions are also discussed, namely, the distribution assumed by Baily (*Phil. Trans.* Roy. Soc., A, vol. clxxxvii., 1896, pp. 715–746), that in any section the electric currents flow in rectangular paths similar to the boundary of the section, and the distribution in which the current density in any path is constant throughout the path.

Dealing with the distribution assumed in connection with the experiments, both graphical treatment and theory agree in giving the formula $3{\cdot}95B^2f^2l^2/10^{16}\rho$ for the watts dissipated per cubic centimetre, where B is the intensity of magnetic induction assumed constant, f is the frequency, l is the length of the cylinder assumed equal to its diameter, and ρ is its specific resistance. In the experiments the frequency was varied from 1/45 to 1/360, and for each the average intensity of induction was varied from 1000 to 20,000. In each case the watts per cubic centimetre are less than would be dictated by the above formula. The ratio of the results is 1·3 at frequency 1/360, and is substantially constant for all values of the induction density. At frequency 1/45 this ratio varies from 1·4 to 1·7 for high and low values of the induction density, but it is 3·1 for an intermediate value. A similar, though less marked, effect is observed at frequency 1/90. The explanation given is that with these intermediate forces at these frequencies very great crowding of the induction to the surface occurs; and, moreover, since the wave-form of the electromotive force near the surface of the cylinder in all the experiments is more rectangular, the dissipation of energy per cubic centimetre is less than the formula above would give, since *there* the wave-form is assumed to be a sine-curve. On the assumption that the electromotive force at the surface is truly rectangular, the formula obtained by graphical treatment is $2{\cdot}08B^2f^2l^2/10^{16}\rho$.

Having reconciled the results of experiment with those of theory, the author compares the dissipation of energy in rotating and alternating magnetic fields. It is pointed out that in the case of circular plates in which the diameter is very great as compared with the thickness, and in which the lines of force are uniformly distributed in the plane of the plate, the rotating field would dissipate about 1·7 times as much energy as an alternating magnetic field in the same time. The results are, however, greatly influenced by variation in wave-form, and even when the lines of force are confined to the plane of the plate, a condition not always met with in practice, the rate of dissipation of energy for a given average induction density may be considerably reduced if the distribution of magnetic induction is such as to give a more rectangular wave-form to the induced electromotive force.

"Note on a Magnetic Detector of Electric Waves, which can be Employed as a Receiver for Space Telegraphy." By G. Marconi, M.I.E.E. Communicated by Dr. J. A. Fleming, F.R.S.

The detector is based, in the author's opinion, on the decrease of magnetic hysteresis which takes place in iron when, under certain conditions, it is exposed to the effects of Hertzian waves. On a core of thin iron wires is wound a coil consisting of one or two layers of insulated copper wire, and over this and separated from it by insulating material is wound a second longer coil. The ends of the inner coil are connected to earth and the aërial conductor, and the ends of the outer coil to a telephone. The iron core is magnetised by a permanent magnet at one end, which is rotated by clockwork so as to cause a continual slow change in the magnetisation. The magnetisation, however, lags behind the magnetic force owing to the hysteresis of the iron, but when a high-frequency current passes through the inner winding there is a decrease in the hysteresis, due